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## PRESENTACIÓN ORAL

### Photometric study of Galactic star clusters in the VVV survey

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**Abstract.** We show the preliminary analysis of some Galactic stellar clusters (GSCls) candidates and the results of the analysis of two new interesting GSCls found in the “VISTA Variables in the Vía Láctea” (VVV) Survey. The VVV photometric data are being used also to improve the knowledge of the Galactic structure. The photometric data are obtained with the new automatic photometric pipeline VVV-SkZ\_pipeline.

**Resumen.** Mostraremos el análisis preliminar de algunos candidatos a cúmulos Galácticos estelares (GSCI) y los resultados de los análisis de dos nuevos interesantes GSCls encontrados en “VISTA Variables in the Vía Láctea” (VVV) Survey. Los datos fotométricos VVV están siendo usados también para mejorar el conocimiento de la estructura Galáctica. Los datos fotométricos fueron obtenidos con la nueva “pipeline” fotométrica automática VVV-SKZ\_pipeline.

## 1. Introduction

Galactic stellar clusters (GSCls) are the perfect laboratories for studying a wide variety of fundamental problems in stellar and galactic astrophysics. They are testbeds for the understanding of stellar dynamics and evolution. They are tracers of the structure, formation and chemical evolution of the Galaxy and its distinct components. It is well studied that the majority of stars with mass  $M > 0.5 M_{\odot}$  form in clustered environment (Lada & Lada 2003).

The discovery of new Galactic globular clusters (GGICl) is important, since they serve as dynamical probes of the Galaxy’s complex kinematics and interaction history, and are cornerstones of the distance scale.

The “Vista Variables in the Vía Láctea” (VVV) Public Survey (Minniti et al. 2010; Saito et al. 2010; Catelan et al. 2011; Saito et al. 2012) is gathering near-IR ( $YZJHK_s$ ) data of the Galactic Bulge ( $-10 \leq l \leq +10, -10 \leq b \leq +5$ ) and the adjacent part of inner disk ( $-65 \leq l \leq -10, -2 \leq b \leq +2$ ). It includes 36 known GGICls and more than 300 open clusters (OpCls). Up to now two new GGICls and a hundred of OpCls were discovered using VVV data (Minniti et al. 2011; Borissova et al. 2011; Moni Bidin et al. 2011).

The analysis of Galactic stellar clusters (GSCls) candidates is not the only important work based on VVV photometry to improve our knowledge of the galactic structure. VVV PSF-fitting photometry of known GSCls is used to

improve the distance of various GSCls (Majaess et al. 2012, in prep) to determine the distance of Cepheids associated to them or their association with the cluster (Majaess et al. 2011, TW Nor and Lyngå 6). The same technique can also be applied to planetary nebulae and this improved knowledge of the distance of GSCls be used to trace better the Galactic arms.

The photometric data are obtained with the new automatic photometric pipeline VVV-SkZ\_pipeline (Mauro et al. 2012, PASP, submitted). The final catalogs were calibrated using the 2MASS catalog (Skrutskie et al. 2006) as standard catalog.

## 2. Photometric Analysis of the candidates

We use a preliminary nomenclature for the candidates, following the one introduced by Minniti et al. (2011), Borissova et al. (2011), and Moni Bidin et al. (2011).

We used a decontamination procedure based on the method of Gallart et al. (2003). For each star in the comparison field, it finds the nearest star located at the  $K_s - (J - K_s)$  plane within a given maximum distance, and rejects it. Stars in the comparison field without a counter-part in the object area are flagged as “unmatched”. More than one comparison field was used to assure a good result of the decontamination.

In this work we show the preliminary results of the photometric analysis of the new candidates. For the analysis of the new GSCls VVV-CL002 and VVV-CL003, here we only note their most interesting characteristic: the first one appears to be one of the innermost GGICls, while the second one seems be the first GSCL located beyond the Galactic Bulge. We refer to Moni Bidin et al. (2011) for more detailed information.

**CL101** The candidate CL101 is located in  $l \simeq 298.550$   $b \simeq -0.162$  (tile d041, Saito et al. 2012). It appears to be a complex system of several Stellar Associations. In Figure 1 in the density map (a product of the VVV-SkZ\_pipeline) the three main overdensity are marked with a 30"-radius circles. The overdensity marked as A is the already discovered, but poorly studied, stellar association (StAs) FSR 1606/Alessi 52 (Dias et al. 2002), while the other 2 main overdensities C and D were unknown. A few arcminutes to the east is also located Ruprecht 102 (Kharchenko et al. 2005), a known, but poorly studied, open cluster. We will use the parameters of the stellar clusters to check if they are coeval and form a unique stellar association.

**CL103** The candidate CL103 is located in  $l \simeq 295.476$   $b \simeq 0.074$  (tile d077). It is a compact object (see Figure 2) with core radius and half-light radius of about 20" and tidal radius of 60". Its decontaminated color-magnitude diagram (CMD) is not well defined, but the top part of its main sequence (MS) and red-giant clump (RGC) are definitely well separated in the comparison with all the four used comparison fields, localized within one-two arcminutes away.

**CL105** The candidate CL105 is located in  $l \simeq 330.035$   $b = \simeq 0.751$  (tile d101). It is a small object (see Figure 3) with core radius and half-light

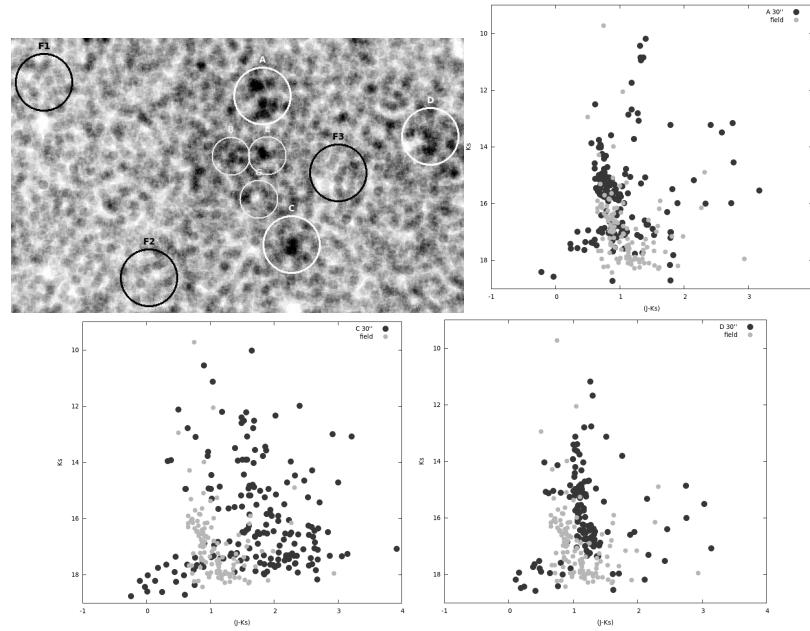


Figure 1. *Top left:* Density map of the stars with magnitude  $K_s \leq 16.0$  for the area of CL101. The three main over-densities A (top), C (bottom) and D (right) and the comparison fields are marked with circles of  $30''$  radius. *Top right and bottom:* Decontaminated color-magnitude diagrams for the three main over-densities with over-plotted a comparison field.

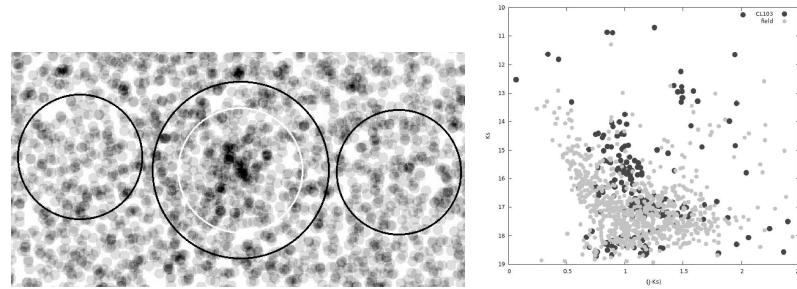


Figure 2. Density map of the stars with magnitude  $K_s \leq 16.5$  for the area (white circle: CL103, black circles: comparison fields; radius  $1'$ ) and decontaminated color-magnitude diagram with over-plotted a comparison field.

radius of about  $12''$  and tidal radius of  $30''$ . The decontaminated CMD shows a sequence characteristic of a young object. The brighter part of the MS of CL105 is located in an area of the CMD poorly populated in the CMD of the several chosen comparison fields.

### 3. Conclusions

In this paper we presented the preliminary analysis of three new stellar-cluster candidates, found in the “VVV - Vista Variables in the Vía Láctea” Survey. All

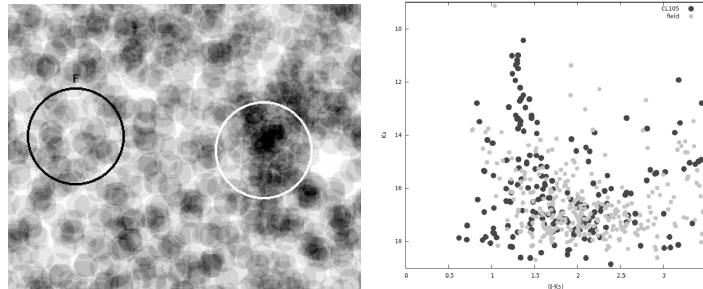


Figure 3. Density map of the stars with magnitude  $K_s \leq 16.5$  for the area (white circle: CL105, black circle: comparison field; radius  $0.5'$ ) and decontaminated color-magnitude diagram with over-plotted a comparison field.

the three candidates present a decontaminated color-magnitude diagram (CMD) showing characteristics that suggest they could be stellar clusters. CL101 is the most interesting candidate since, presenting several likely stellar clusters in several tenth of square arcminutes, it could have been a active star-forming area. We aim to study it further to determine if it is a single stellar association.

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